

RDL-2000

Broadband Wireless Radio Platform



Installation Guidelines

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1 Important Safety & Service Notices

1.1 Safety Warnings

1.  PoE power adapter for RDL-2000:

Warning to Service Personnel: 48 VDC

Customer equipment including personal computers, routers, etc., must be connected only to the INPUT (DATA) port on the PoE unit.

Only the outdoors Ethernet interface cable connecting to the unit can be safely connected to the OUTPUT (DATA & POWER OUT) connector. Connecting customer premises Ethernet equipment directly to the OUTPUT (DATA & POWER OUT) connector on the Power-over-Ethernet power adapter may damage customer equipment.

2. Installation of the system must be contracted to a professional installer.
3. The installer is responsible for ensuring that the system is used exclusively for fixed, point-to point operations.
4. Read this user manual and follow all operating and safety instructions.
5. Keep all product information for future reference.
6. The power requirements are indicated on the product-marking label. Do not exceed the described limits.
7. Disconnect the power before cleaning. Use only a damp cloth for cleaning. Do not use liquid or aerosol cleaners.
8. Disconnect power when unit is stored for long periods.
9. The unit must not be located near power lines or other electrical power circuits.
10. The system must be properly grounded to protect against power surges and accumulated static electricity. It is the user's responsibility to install this device in accordance with the local electrical codes: correct installation procedures for grounding the unit, mast, lead-in wire and discharge unit, location of discharge unit, size of grounding conductors and connection requirements for grounding electrodes.

1.2 Warning Symbols

The following symbols may be encountered during installation or troubleshooting. These warning symbols mean danger. Bodily injury may result if you are not aware of the safety hazards involved in working with electrical equipment and radio transmitters. Familiarize yourself with standard safety practices before continuing.



Electro-Magnetic Radiation



High Voltage

1.3 Service & Warranty Information

Refer all repairs to qualified service personnel. Do not remove the covers or modify any part of this device, as this action will void the warranty.

Locate the serial numbers and record these on your registration card for future reference. Use the space below to affix serial number stickers. Also, record the MAC address identified on the unit product label.

Redline does not endorse or support the use of outdoor cable assemblies: i) not supplied by Redline, ii) third-party products that do not meet Redline's cable and connector assembly specifications, or iii) cables not installed and weatherproofed as specified in the Installation Guidelines manual (70-00073-01-XX). Refer to the Redline Limited Standard Warranty and RedCare service agreements.

1.4 Lightning Protection

WARNING: The following notes are general recommendations for the system. The wireless equipment should be installed by a qualified professional installer who is knowledgeable of and follows local and national codes for electrical grounding and safety. Failure to meet safety requirements and/or use of non-standard practices and procedures could result in personal injury and damage to equipment.

All outdoor wireless equipment is susceptible to lightning damage from a direct hit or induced current from a near strike. A direct lightning strike may cause serious damage even if these guidelines are followed. Lightning protection and grounding practices in local and national electrical codes serve to minimize equipment damage, service outages, and serious injury. Reasons for lightning damage are summarized as:

- a) Poorly grounded antenna sites can conduct high lightning strike energy into equipment.
- b) Lack of properly installed lightning protection equipment can cause equipment failures from lightning induced currents.

A lightning protection system provides a means by which the energy may enter earth without passing through and damaging parts of a structure. A lightning protection system does not prevent lightning from striking; it provides a means for preventing damage to equipment by providing a low resistance path for the discharge of energy to travel safely to ground. Improperly grounded connections are also a source of noise that can cause sensitive equipment to malfunction.

A good grounding system disperses most of the surge energy from a lightning strike away from the building and equipment. The remaining energy on the Ethernet cable shield and conductors can be directed safely to ground by installing a lightning arrestor in series with the cable.

If you have determined that it is appropriate to install lightning protection for your system, the following general industry practices are provided as a guideline only:


1. The AC wall outlet ground for the indoor POE adapter should be connected to the building grounding system.
2. Install a lightning arrestor in series with the Ethernet cable at the point of entry to the building. The grounding wire should be connected to the same termination point used for the tower or mast.
3. Install a lightning arrestor in series with the Ethernet cable as close to the outdoors unit as practical. The grounding wire should be connected to the same termination point used for the tower or mast.

4. Provide direct grounding from the unit, the mounting bracket, the antenna, and the Ethernet cable surge protection to the same ground bus on the building. Use the grounding screws provided for terminating the ground wires.

1.5 Deployment in the USA and Canada

1.6 FCC & IC Notices

1. The Model RDL-2000 and its antenna must be professionally installed.

2.  **WARNING** -- FCC & IC RF Exposure Warnings

To satisfy FCC and IC RF exposure requirements for RF transmitting devices, the following distances should be maintained between the antenna of this device and persons during device operation:

Table 1: FCC & IC RF Recommended Safe Separation Distances		
Frequency (GHz)	Mode	Separation Distance
5.4	PTP	40 cm (16 in) or more
5.8	PTP	354 cm (140 in) or more

To ensure compliance, operation at closer than these distances is not recommended. The antenna used for this transmitter must not be collocated in conjunction with any other antenna or transmitter.

3. High power radars are allocated as primary users (meaning they have priority) of 5.250-5.350 MHz and 5.650-5.850 GHz and these radars could cause interference and/or damage to LE-LAN devices.
4. FCC Information to Users @ FCC 15.105:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Where DFS is required by regional regulations, this function is permanently enabled at the factory and can not be disabled by the installer or end-user.

5. FCC Information to Users @ FCC 15.21:

Warning: Changes or modifications not expressly approved by Redline Communications could void the user's authority to operate the equipment.

1.7 UL Information

1. The suitability of the supplied Ethernet cable is subject to the approval of Authority Having Jurisdiction and must comply with the local electrical code.
2. The equipment must be properly grounded according with NEC and other local safety code and building code requirements
3. To meet the over-voltage safety requirements on the telecommunications cables, a minimum 26 AWG telecommunication line cord must be used.
4. "Pour être en conformance avec les exigences finies de sûreté de sur-tension sur les câbles de télécommunications un fil de télécommunication ayant un calibre minimum de 26 AWG doit être utilisé."
5. Reminder to all the BWA system installers: Attention to Section 820-40 of the NEC which provides guidelines for proper grounding and, in particular, specifies that the cable ground shall be connected to the grounding system of the building, as close to the point of cable entry as is practical.
6. RDL-2000 must be installed in compliance with relevant articles in National Electrical Code-NEC (and equivalent Canadian Code-CEC) including referenced articles 725, 800 and 810 in NEC.
7. RF coaxial cable connecting an antenna to the RDL-2000 must comply with the local electrical code.

1.8 Product Information

Use the following table to record important system information:

Product Information
RDL-2000 SN: _____ MAC Address _____
PoE SN: _____ Model #: _____
Antenna SN: _____ Model # _____
Serial Number Stickers

2 Introduction

The RDL-2000 is a high-performance, high-speed wireless Ethernet bridge for use in a commercial, industrial, business, or government environment. The system includes a 5.4 - 5.8 GHz radio using a time division duplexing (TDD) RF transceiver to transmit and receive on the same channel.

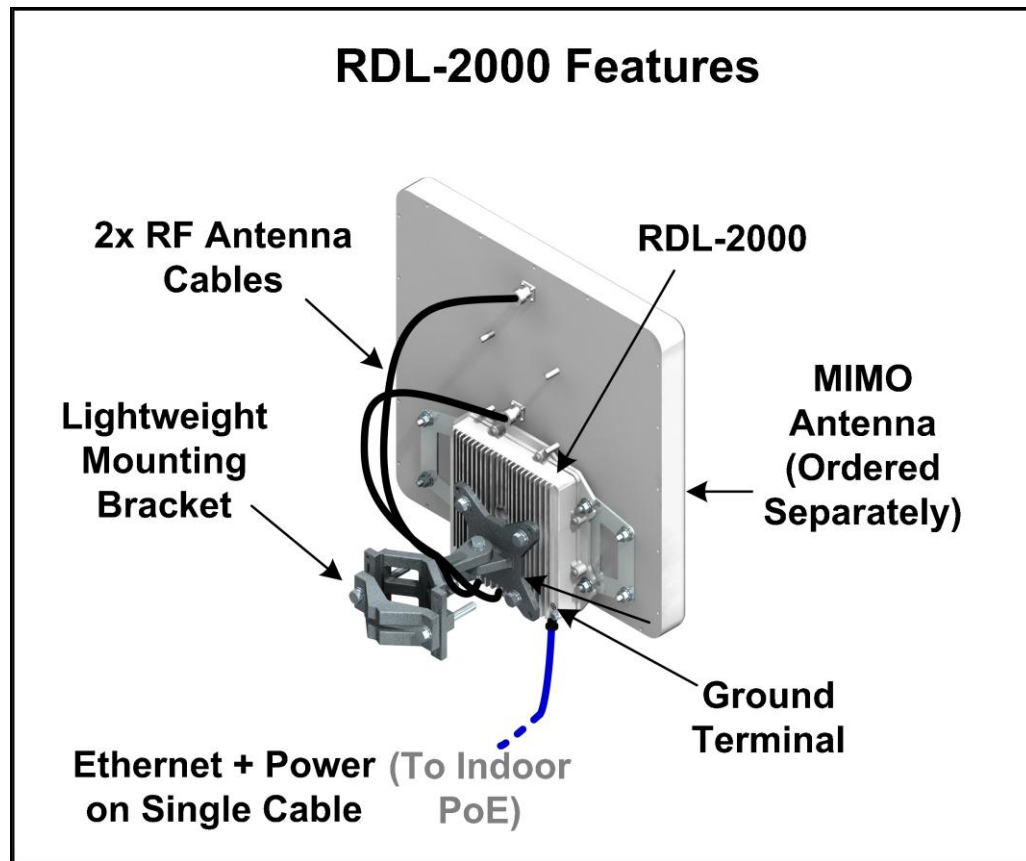


Figure 1: Overview - RDL-2000 System Features

The all-outdoor radio is housed in a weatherproof aluminum alloy case and can be used with external flat panel or parabolic antennas. When equipped with a narrow beam antenna the RDL-2000 supports long-range operations in clear line of sight (LOS) conditions. An indoor PoE power adapter provides operational power for the RDL-2000 and connectivity to the local Ethernet network using a standard outdoor approved Ethernet cable.

For each PTP link, one RDL-2000 is configured as Master Unit (MU) and controls the wireless link. This function is transparent to all Ethernet operations. The Master uses a scheduled request/grant mechanism to arbitrate bandwidth requests from the remote Slave Unit (SU) to provide non contention based traffic with predictable transmission characteristics. A unique identifier (MU ID) can be specified to ensure wireless links are established only between designated pairs of RDL-2000 units. Encryption can be enabled for secure data transmission over the air.

3 Site Survey Information

Before installing the RDL-2000 equipment, a site survey should be completed and this data should be available to the installation team. This data will assist the installer to install the RDL-2000 correctly, and to understand the operating characteristics of the wireless system during configuration and testing.

3.1 RF Interference

Frequency planning is an essential component of installation and it is very important to test for RF interference at every installation site. The RDL-2000 will not achieve full operational capability if there is excessive interference.

RF interference may be caused by another wireless system operating on the same RF channel or adjacent channels. A simple test may be performed using the RDL-2000 built-in Spectrum Sweep feature to determine if a selected RF channel is generally free from interference. The RDL-2000 also includes an automatic channel selection feature, to choose the channel with the lowest detected level of interference. Refer to the RDL-2000 User Manual for a description of these features.

3.2 Path Profile

The site survey should identify the optimum location for mounting the RDL-2000. For maximum performance, there should be a direct line of sight between the Master and Slave system.

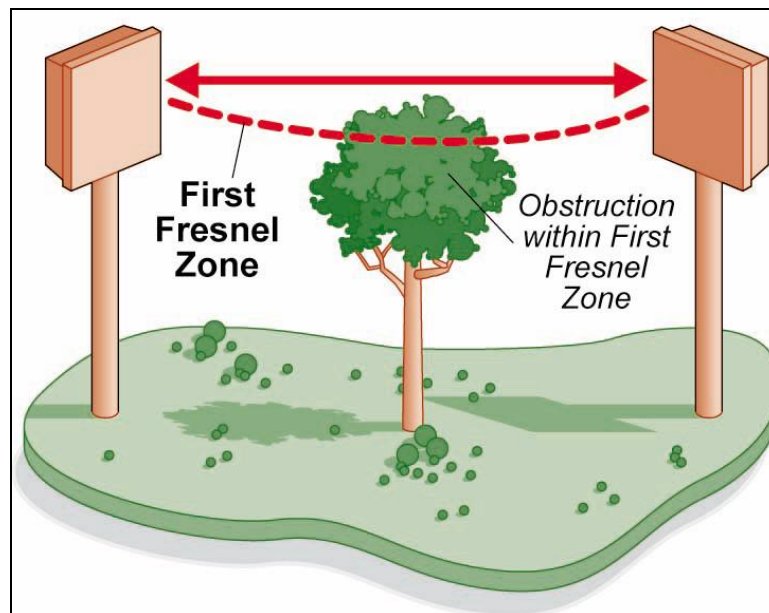


Figure 2: Site Survey - Fresnel Zone Radius

The antenna should be positioned to provide maximum clearance within the first Fresnel zone of the direct path (as high as possible, on either a tall building or tower). A clear line-of-sight (LOS) path requires clearance above natural and man-made objects by at least 60% of the First Fresnel zone.

The RDL-2000 will also function under optical line-of-sight (OLOS) conditions; where a clear straight line path exists between the two end points, but the first Fresnel zone is not clear. If the optical path is completely blocked, it may still be possible to establish a non line-of-sight (NLOS) path using reflections and diffraction. A satisfactory multipath RF signal may be obtained by directing both RDL-2000 antennas towards a reflective structure that is within sight of both units.

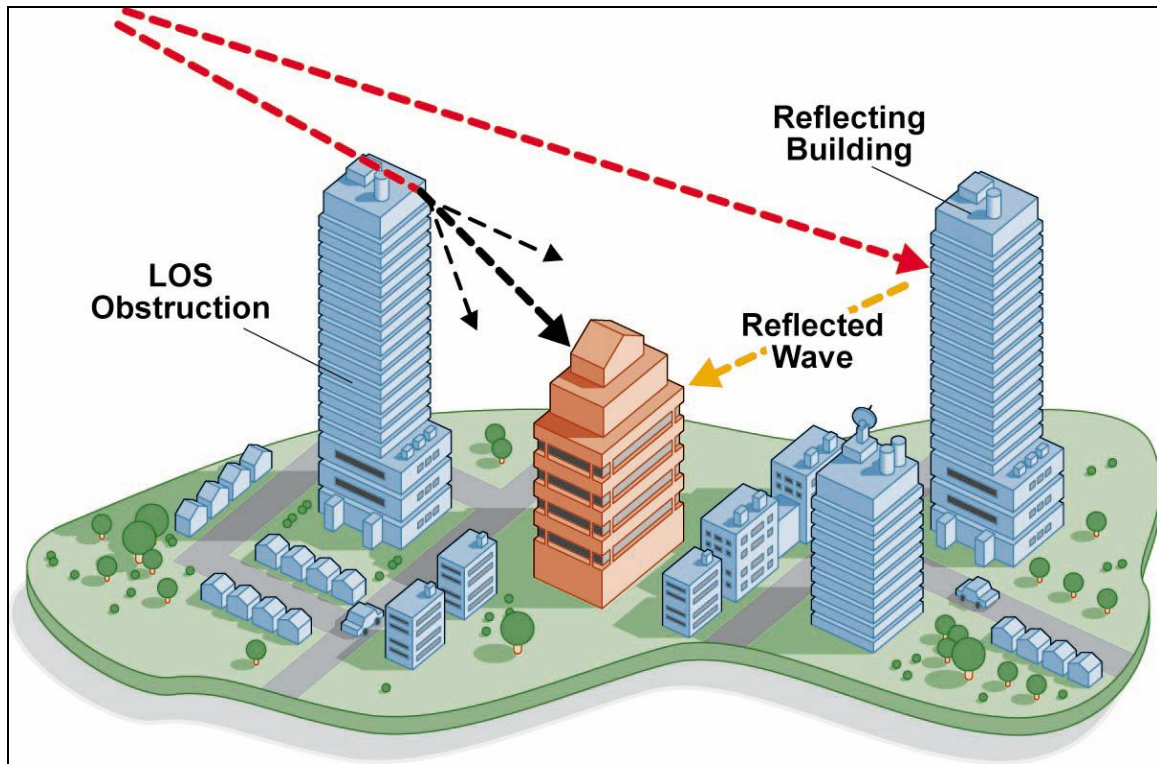


Figure 3: Site Survey - Non-Line of Sight Deployment

The path profile should include the following information:

Table 2: Site Survey - Site Path Profile Data	
Antenna	Description
Location	Instructions to identify the location for installing the antenna. May include blueprints and specify material list.
Height	Mounting height for antenna.
Azimuth	Horizontal aiming direction for the antenna (magnetic or GPS compass)
Elevation angle	Vertical aiming for antenna (spirit level).
Expected RSSI	Use the Link Budget tool to determine the expected receive signal strength indication (RSSI).

3.3 Deployment Information

Following installation, each RDL-2000 must be configured for operation with a local Ethernet network. Contact your network system administrator for details.

The following network and RF plan information is required to configure the wireless link.

Table 3: Site Survey - Network Plan Data

Network	Setting	Master	Slave
Plan	IP Address		
	Network Mask		

Table 4: Site Survey - RF Plan Data

RF	Setting	Master	Slave
Plan	MU ID		(same as Master)
	Band		(same as Master)
	Channel BW		(same as Master)
	M. Tx Power		(same as Master)
	Channel/RF Channels		
	Antenna Gain		

Table 5: Site Survey - Additional Parameters

Setting	Description
Ethernet Mode	Speed and duplex options.
VLAN	Necessary if using VLAN for device management.

4 Installation Procedures

4.1 Overview

The components in the following illustration are supplied with each RDL-2000 system.

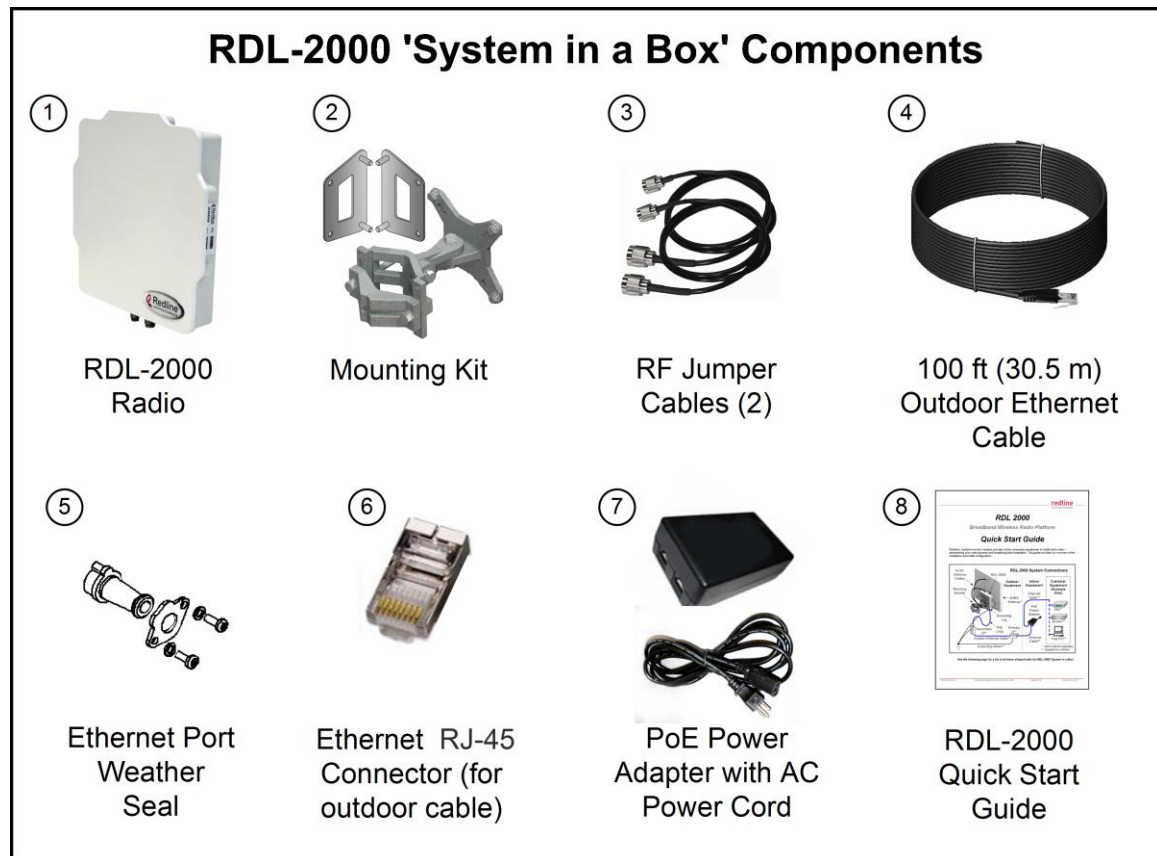


Figure 4: Installation - Redline Supplied Components

4.1.1 Redline Supplied System Components

The following items are provided with each RDL-2000 system. Antenna systems and lightning protection devices must be ordered separately.

Table 6: Installation - Redline-Supplied Items

Item	Description
1	RDL-2000 Radio
2	Universal mounting bracket with assembly hardware. Bracket adjusts for a 44.5 mm to 76.2 mm (1.75 in to 3.00 in) mast pipe or mounts directly to a flat surface. Assembly is required.
3	Two 75 cm (29.5 in) RF jumper cables to connect the RDL-2000 to the MIMO antenna system.
4	30.5 m (100 ft) Cat-5e shielded outdoor Ethernet cable with single RJ-45 connector termination (indoor connection). The outdoor end of the cable must be terminated by the installer using the supplied RJ-45 connector (after installing the RDL-2000 Ethernet port weatherproof grommet and mounting plate on the cable).
5	Ethernet port weatherproofing grommet, plate, and mounting screws.
6	RJ- 45 connector for terminating Cat-5 cable.
7	PoE power injector: with single AC 110/220 VAC input, single 10/100 Ethernet data port, plus single 10/100 powered Ethernet port. Includes AC power cord with type-B plug.
8	Quick Start Guide (this document).

4.1.2 Customer Supplied Materials

Installation of the RDL-2000 equipment requires additional equipment and materials supplied by the customer. The following list is provided as a guideline only, and additional materials may be required based on local conditions at each installation site. This list is not comprehensive and is provided as a guide only.

Table 7: Installation - Customer-Supplied Items		
#	Item	Description
1	Equipment Rack	Mounting space allocated for the PoE power adapter. Must accommodate 2 m (6') AC power cable and routing of Ethernet cable from PoE to local Ethernet network access point.
2	120/240 VAC Power	Reliable 120/240 VAC. Total power requirements must be evaluated based on individual site configurations.
3	Cat-5 Ethernet Cables	Connect from PoE power adapter to core network.
4	Cable Installation Materials	Materials for securing cables to mast, protecting cables from abrasion, etc. including suggested weatherproofing materials: Scotch 2200 series of vinyl mastic rolls Scotch 130C linerless rubber splicing tape 3M Scotch super 88 electrical tape Rubber mastic putty or duct sealing putty
5	Radio/Antenna Mast	Mast or tower location as required by site survey. Equipment must be rated for weight and wind loading of all installed radios and antennas.
6	Ground Block	Termination for grounding and shield of all conductive cables entering the building.
7	Grounding Wire	Master grounding system for all indoor and outdoor equipment, with #2 AWG through #6 AWG as required and eye-terminals for connection to RDL-2000 chassis and mounting bracket.
8	Tools	i) Equipment to terminate CAT-5 Ethernet cable with RJ-45 connector (e.g., AMP 2-231652 or equivalent). ii) Precision set of screwdrivers, cutter pliers, and other common installation tools. iii) Portable computer (Windows™) for RDL-2000 configuration, antenna alignment, and troubleshooting as required.

4.1.3 Installation Overview

The following diagram illustrates a typical RDL-2000 installation. When using flat panel antennas, the RDL-2000 radio and antenna are both secured to the same mounting bracket. When using parabolic antennas, the radio may be mounted separately. Power and data are supplied to the RDL-2000 using an outdoor-rated Ethernet cable. The power injector (PoE) must be located inside a weatherproof enclosure, with access to reliable AC and connection to the local network. Optional surge arrestor may be ordered and installed if there are concerns about damage from lightning strikes.

⚠ CAUTION Surge protection must be provided where any outdoor cabling enters a building. Refer to local building and electrical codes.

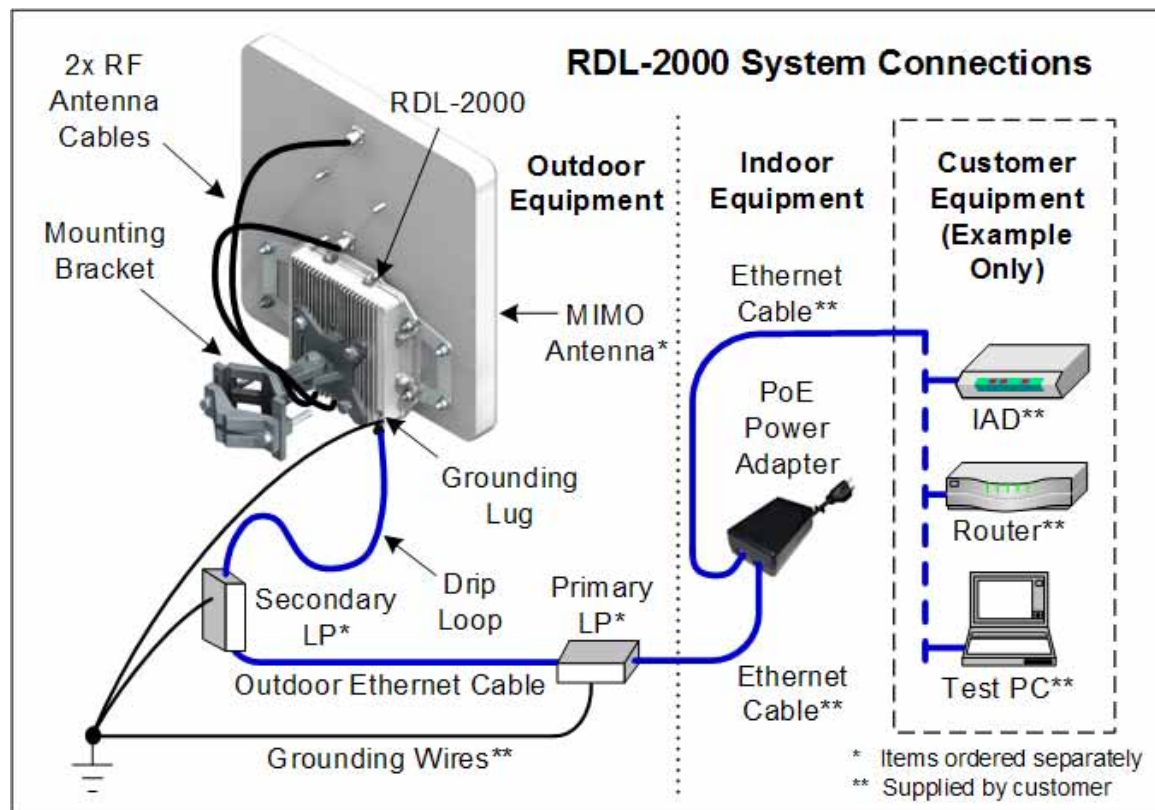


Figure 5: Installation - RDL-2000 System Components

4.2 Step 1: Assemble Antenna Bracket

4.2.1 Lightweight Mounting Kit

The RDL-2000 lightweight mounting kit general-purpose adapter allows the RDL-2000 to be mounted on a mast pipe or flat surface. This bracket can be used with Redline flat panel antennas that mount directly to the radio or with antennas that are mounted separately (e.g., parabolic antenna).

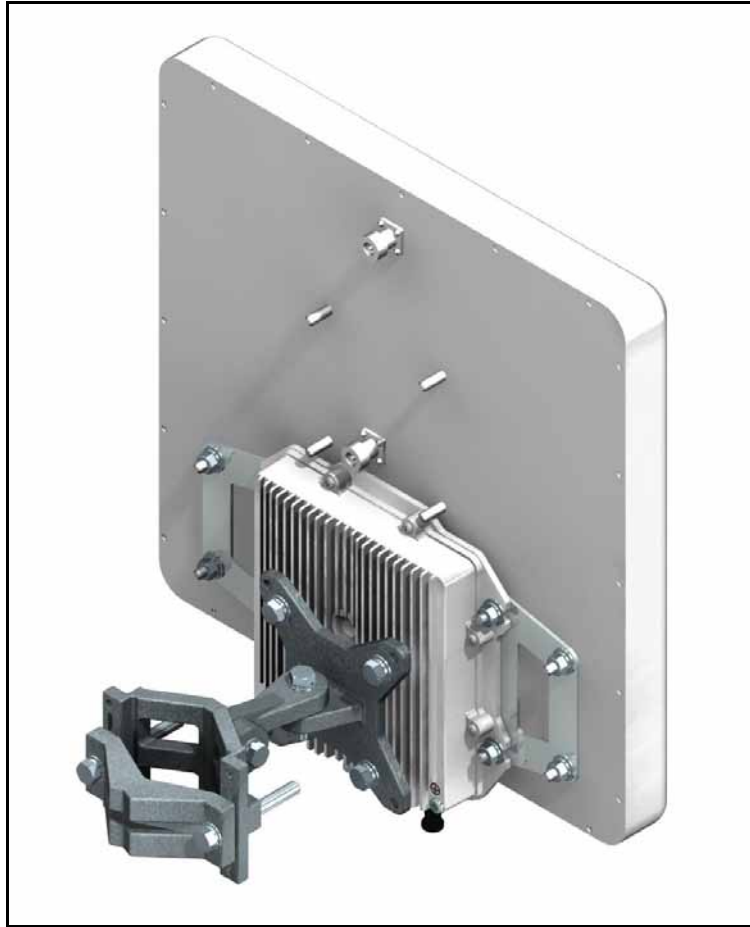


Figure 6: Procedures - Lightweight Mounting Kit - Installed View

The lightweight installation kit includes:

1. Universal mounting bracket with assembly hardware. Bracket adjusts for a 44.5 mm to 76.2 mm (1.75 in to 3.00 in) mast pipe or mounts directly to a flat surface. Assembly is required.
2. Two 406 mm (16 in) RF jumper cables (N-type connectors, 50 Ohm).

Use the following parts list and diagram to assemble the mounting bracket and attach the RDL-2000 radio and antenna.

1. Assemble the lightweight mounting bracket. See the following assembly drawings.
2. Attach the RDL-2000 unit directly to the antenna (if applicable).
3. Attach the lightweight mounting bracket to the RDL-2000.

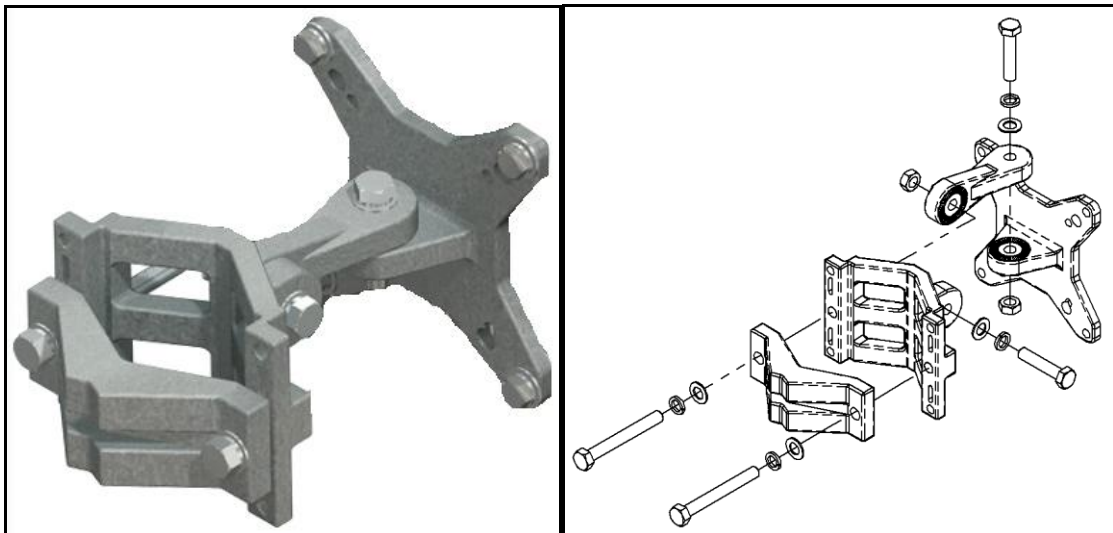


Figure 7: Procedures - Lightweight Mounting Kit - Bracket Arm

Table 8: Procedures - Lightweight Mounting Bracket - Parts List			
Item	Qty	Description	Torque
1	1	RDL-2000 Radio*	
2	1	Mount Bracket Arm Kit	
3	1	Antenna*	
4	4	Bolt 1/4-20 UNC X 3/4	13.56 N-m (10 ft-lb.)
5	4	Nut, 1/4-20 UNC	13.56 N-m (10 ft-lb.)
6	8	Washer, 1/4 flat	
7	8	Washer, 1/4, split	
8	2	230 mm (9 in) RF cables. N-type connectors, 50 Ohm	12 lb-in (1.35 N-m)

* Item not included in the mounting bracket kit.

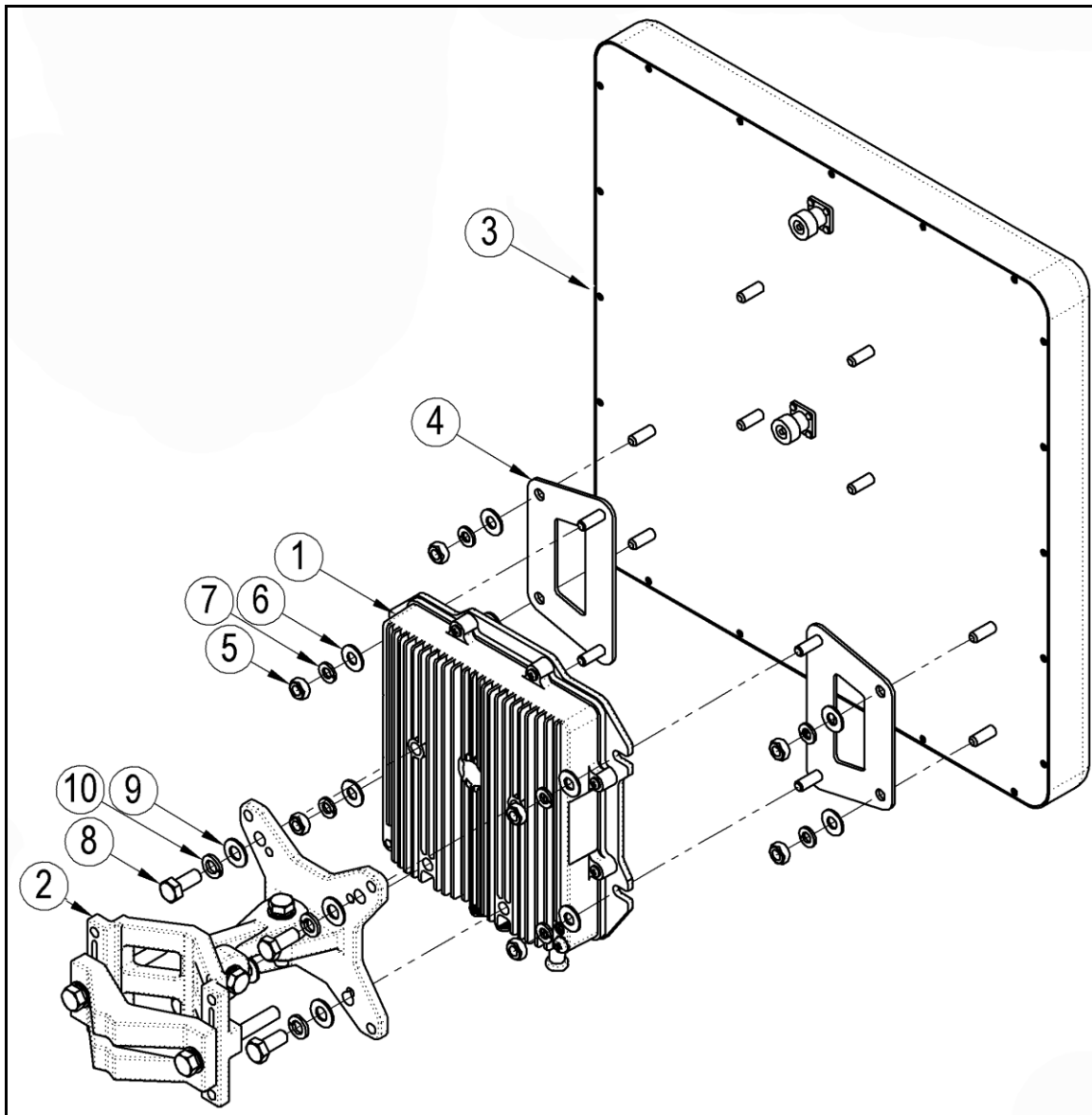


Figure 8: Procedures - Lightweight Mounting Kit - Assembly Drawing

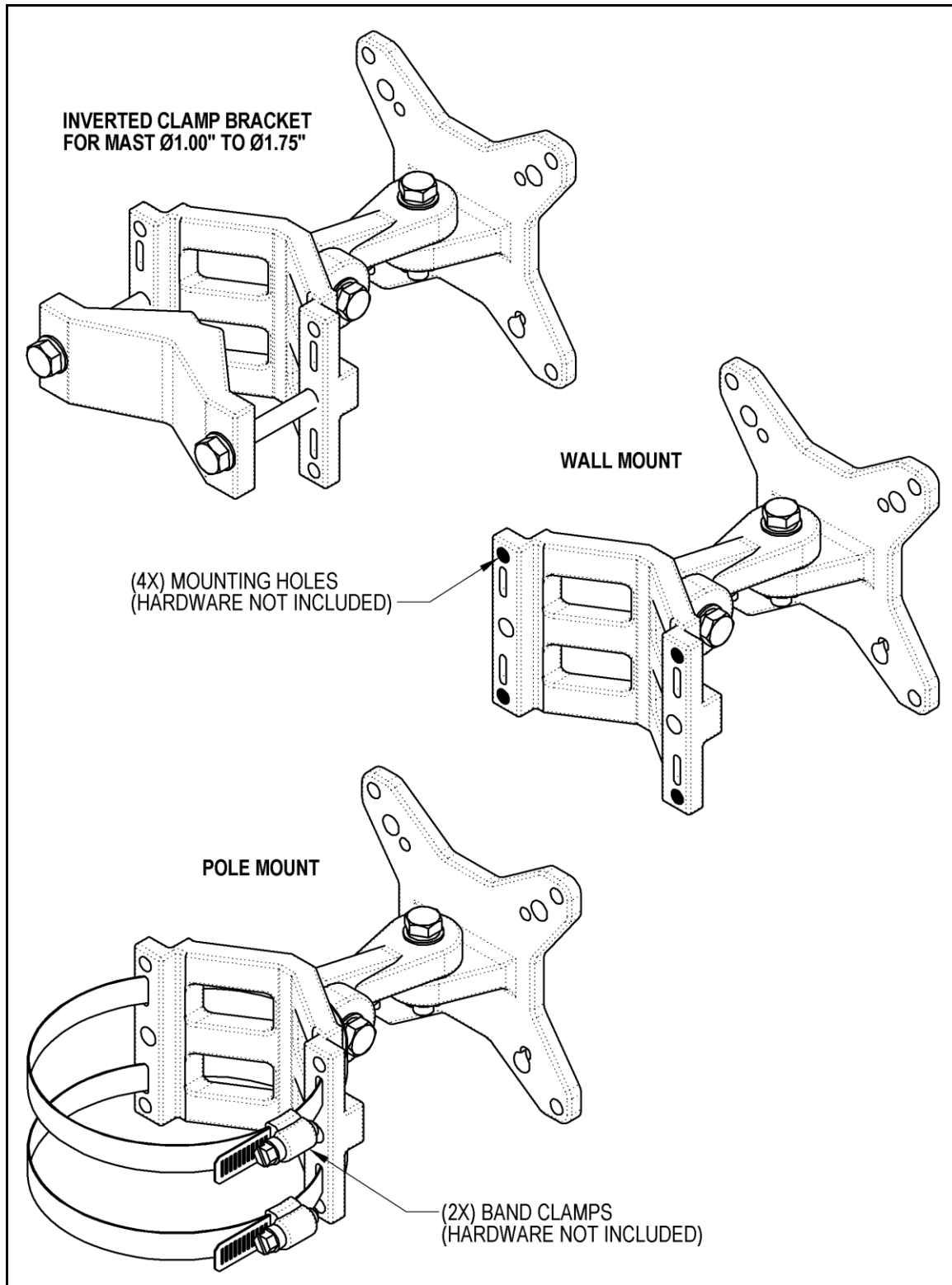


Figure 9: Procedures - Alternate Mounting Methods

4.3 Step 2: RF Connections

A pair of RF cables are provided to connect the RDL-2000 to the antenna system. Both ends of the RF cables must be weatherproofed. This section describes how to connect the RF cables and the recommended weatherproofing procedures.

NOTICE : Outdoor Cable Assembly

Redline does not endorse or support the use of outdoor cable assemblies: i) not supplied by Redline, ii) third-party products that do not meet Redline's cable and connector assembly specifications, or iii) cables not installed and weatherproofed as specified in this manual. Redline warranty and service obligations will be voided under the conditions listed above. Refer to the Redline Limited Standard Warranty and RedCare service agreements for details.

4.3.1 RF Ports

The RF ports (2x female TNC connectors) are used to conduct RF signals between the RDL-2000 and the antenna system. Refer to Figure 10: Installation - RDL-2000 RF Ports for the port locations.

RF Port 0: This port is always active. Use RF Port 0 when deploying a SISO (single antenna) system.

RF Port 1: This port is activated when MIMO operation is enabled in the system configuration.

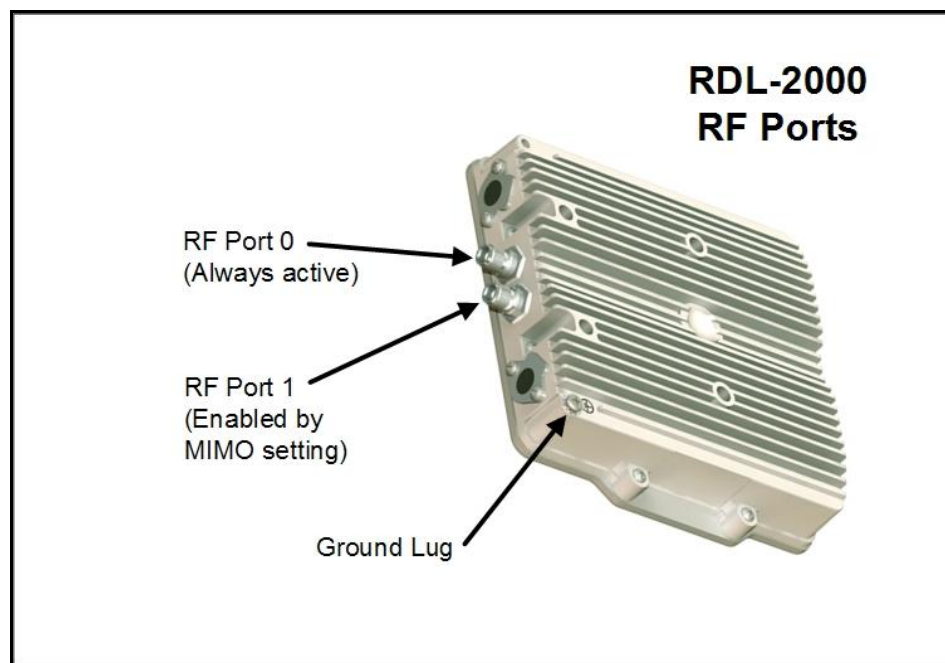


Figure 10: Installation - RDL-2000 RF Ports

Note: When deploying a MIMO system, it is not required to match the antenna connections (RF Port 0/ RF Port 1) between the antenna systems at each end of the wireless link.

4.3.2 RF Cable Connections

Two RF jumper cables are provided with each RDL-2000 unit. The RF cables conduct RF signals between the RDL-2000 and antenna system. Each 75 cm (29.5 in) cable is terminated female BNC to Type-N.



Figure 11: Installation - RF Jumper Cable

4.3.3 Connections RF Cables

Apply a small amount of weatherproofing grease to weatherproof the connector threads on each RF cable. Connect the RF cables between the RDL-2000 RF ports and the antenna RF ports. The connectors must be finger-tight only. Using excessive force or the incorrect tools will damage the connectors on the antenna and RDL-2000 and defeat the connector weatherproofing features.

Outdoor Cable Assembly Weatherproofing

The TNC-type connectors on the RDL-2000 and the antenna must be weatherproofed. This section provides a pictorial primer on correct weatherproofing procedures.

Redline does not recommend silicon seal or glue as these materials are difficult to apply accurately, can leave gaps, and are difficult to remove. Do not use PVC tape.

4.3.4 Weatherproofing RF Connectors

The importance of proper weatherproofing can not be overstressed. Inadequate weatherproofing can result in damage to equipment and higher maintenance costs. Both ends of the RF cable must be weatherproofed.

The following sealing tapes are recommended for weatherproofing:

- Scotch 2200 series of Vinyl Mastic rolls
- Scotch 130C Linerless Rubber Splicing Tape
- 3M Scotch Super 88 Electrical Tape

These are heavy-duty weather, abrasion, and UV resistant tapes that can be purchased at most hardware stores. Rubber mastic putty or duct sealing putty must also be used to complete the weatherproofing. The professional installer may use his own weatherproofing materials provided they are not silicon-based.

1. Begin to wrap the splicing tape. Start as close as possible to the chassis.



Figure 12: Installation - RF Port Weatherproofing - Pt-1

2. Stretch and wind the tape back along the connector housing making very sure there are no gaps in the tape.



Figure 13: Installation - RF Port Weatherproofing - Pt-2

3. Continue to wrap the tape tightly along the cable.

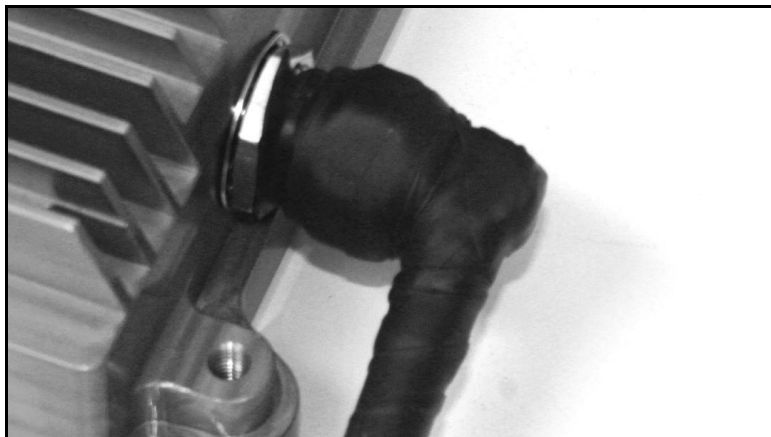


Figure 14: Installation - RF Port Weatherproofing - Pt-3

4. When the taping is complete, work the mastic putty well into the area between the connector and the body of the radio. Continue working the putty to make a watertight seal.



Figure 15: Installation - RF Port Weatherproofing - Pt-4

The connection is now well weatherproofed. Repeat this procedure for each RF connector on the RDL-2000 and the antenna system.

4.4 Step 3: Ethernet Connections

An outdoor Ethernet cable is provided to connect the RDL-2000 to the local network. This section describes how to connect and weatherproof the Ethernet cable.



Important -- RDL-2000 Ethernet Cables

The maximum total length of the Ethernet cable is 100 m (328 ft). For example, 98 m (322 ft) from the RDL-2000 to the PoE and an additional 2 m (6 ft) from the PoE to the network equipment.

4.4.1 Ethernet Ports

The RDL-2000 has two Ethernet ports (female RJ-45 connectors) used to receive DC power from the PoE and exchange data with the local Ethernet network. The ports provide identical functions. Refer to Figure 16: Installation - RDL-2000 Ethernet Ports for the port locations.

Ethernet Port 1: This port is sealed at the factory. Use Ethernet Port 2.

Ethernet Port 2: Use this Ethernet port for normal operation.

NOTICE The RDL-2000 Ethernet port uses a custom pinout for the PoE signals. All Ethernet cables from the indoor PoE to the outdoor RDL-2000 must be terminated to match the specifications in this manual.

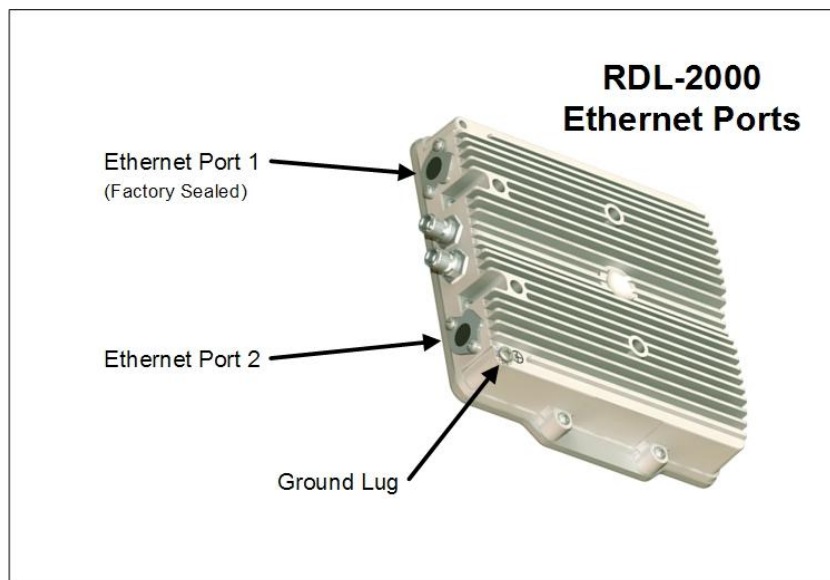


Figure 16: Installation - RDL-2000 Ethernet Ports

4.4.2 Terminating the Ethernet Cable

The outdoor Ethernet cable is supplied with a single RJ-45 connector for terminating to the indoor PoE. The system installer must prepare this cable by:

1. Install the Ethernet port weatherproof grommet and clamp onto the cable.
2. Terminate the cable using the supplied RJ-45 connector.
3. Connect the cable to the RDL-2000 Ethernet port.
4. Weatherproof the RDL-2000 Ethernet port.

NOTICE The Ethernet cable must be inserted through the mounting plate and grommet before the RJ-45 connector is installed on outdoor Ethernet cable.

When assembled correctly, the Ethernet port seal will be weather-resistant.

Use the following steps to:

1. Install the Ethernet port weatherproof grommet and clamp onto the cable.
 - a. Insert the grommet into the grommet clamping plate. The grommet must be threaded through the metal clamping plate first. This operation will not be possible after the Ethernet cable has been inserted through the grommet.
 - b. Thread the Ethernet cable through the rubber grommet/metal clamping plate combination (see Figure 17). The large end of the grommet should be oriented towards the unterminated end of the cable.

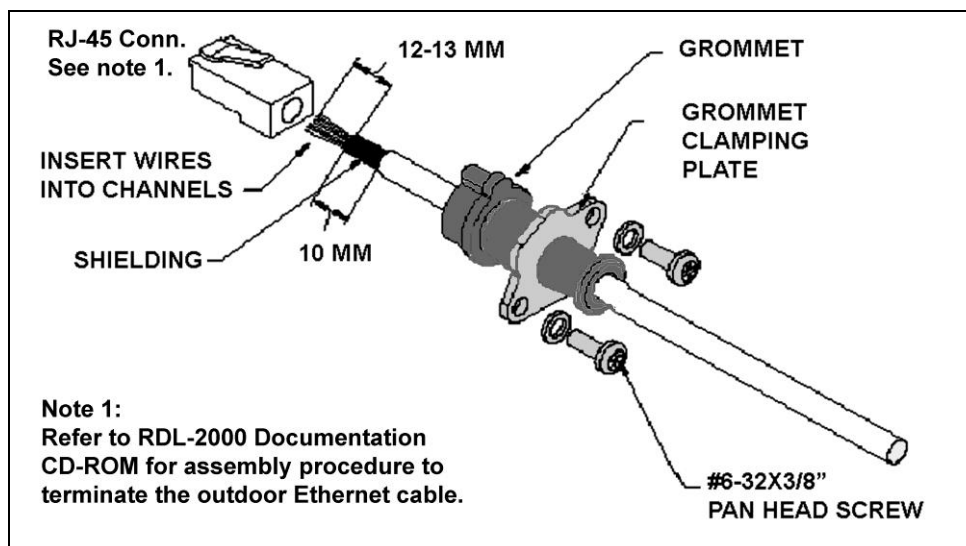








Figure 17: Installation - Ethernet Port Cover Plate & Grommet

2. Terminate the cable using the supplied RJ-45 connector. The RDL-2000 Ethernet port uses a custom pinout for the PoE signals. All Ethernet cables from the indoor PoE to the outdoor RDL-2000 must be terminated to match the specifications in Table 9.

Table 9: Installation - Outdoor Ethernet Cable Termination			
RJ-45 Conn.	Signal	Color Code	Identification
1	RX +		White / Orange
2	Rx -		Orange
3	Tx +		White / Green
4	No Connection		
5	No Connection		
6	Tx -		Green
7	+Ve		Blue
8	-Ve		Brown

Note: Color codes are provided for convenience only. All signals must match the connector assignments. Do not terminate wires to pins 4 and 5 on the RJ-45 connector.

3. Connect the cable to the RDL-2000 Ethernet port by inserting the RJ-45 plug into the mating RDL-2000 Ethernet port connector.

NOTICE Ethernet Plug Must 'Click' into Socket

Inserting the RJ-45 plug into the mating socket should result in an audible 'click' from the locking mechanism. Ensure the connector is locked in position. Do not use cables where the locking tab is broken or has been removed!

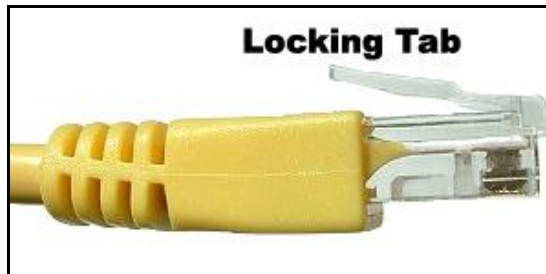


Figure 18: Installation - Ethernet Connector Locking Tab

NOTICE It is strongly recommended to test the Ethernet cable by connecting the RDL-2000 to a PoE and verifying connectivity (e.g., ping from a connected PC) before sealing and weatherproofing the RDL-2000.

4. Weatherproof the RDL-2000 Ethernet port.
Position the grommet and clamping plate against the Ethernet port opening and install the two NC-6 screws with spring washers to seal the port (see Figure 19).



Figure 19: Installation - Ethernet Port Weatherproofing

Apply adequate weatherproofing (putty and tape) to protect the Ethernet ports. While the Ethernet connection is weatherproof, it is always advisable to provide additional weatherproofing. Use the same procedure as for the RF cable connections (refer to section 4.3.4: Weatherproofing RF Connectors on page 24).

4.4.3 Disconnecting the Ethernet Cable

The RJ-45 connector is recessed within the RDL-2000 chassis. To disconnect the Ethernet cable from the RDL-2000, you must use a small flat blade screwdriver or similar tool release the locking tab located in the chassis recess.

1. Use a small flat blade screwdriver or similar tool to carefully depress the locking tab on the Ethernet plug.
2. Maintain pressure on the tab and use only a light pull (two fingers) to remove the Ethernet plug from the socket. The cable must be pulled straight out the port or the connector may be caught on the chassis metal housing.

NOTICE Ethernet Cable Removal

Use of excessive force when removing the Ethernet cable will damage the RJ-45 connector and the RDL-2000 printed circuit board.

If the weatherproofing grommet has been installed, care must be taken to avoid excessive strain on the RJ-45 connector when moving the grommet to gain access the release pin on the connector. Be sure to push the Ethernet cable through the grommet hole as the grommet is moved away from the RDL-2000 port.

4.5 Step 4: Installing the RDL-2000

This section describes mounting the RDL-2000, recommendations for grounding and line protection equipment, and basic antenna alignment.

⚠ CAUTION RDL-2000 Installation Guidelines

The following are general guidelines for system installation. The RDL-2000 must be installed by a qualified professional installer and follow local and national building codes and codes for electrical grounding and safety.

Failure to meet safety requirements and/or use of non-standard practices and procedures could result in personal injury and damage to equipment. A direct lightning hit may cause serious damage or injury even if these guidelines are followed for the system. A direct lightning hit may cause serious damage or injury even if these guidelines are followed for the system.

Do not install outdoor components during adverse weather conditions when the threat of a lightning strike is possible.

4.5.1 Mounting the RDL-2000

NOTICE It is recommended to pre-assemble and test the RDL-2000 equipment (RDL-2000, mounting bracket, and antenna) and connection wiring before final installation of the units. Refer to 5.2: Bench Test Setup on page 50.

The standard mounting kit may be used with 305 or 370 mm (12 or 14.5 in) flat panel antennas where the RDL-2000 is installed on towers or similar locations. The mounting bracket adjusts to fit 4.45 mm to 11.73 cm (1.75 in to 4.62 in) mast pipe.

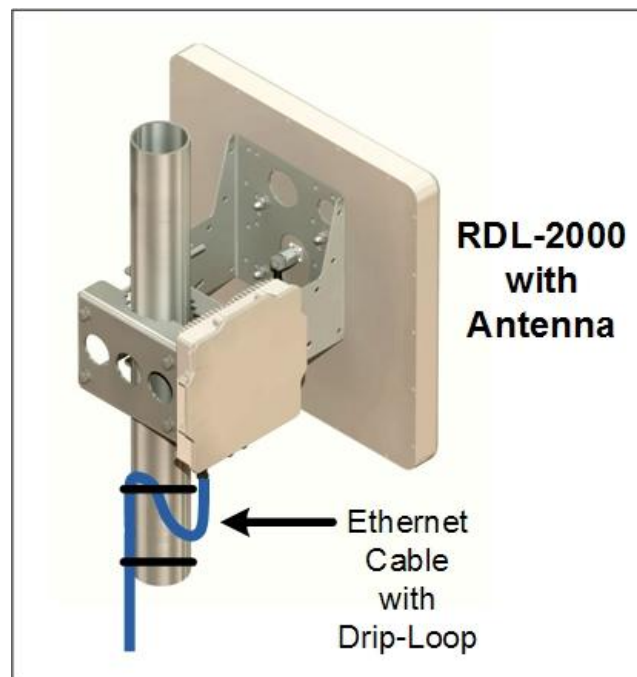


Figure 20: Installation - RDL-2000 (with Ethernet Drip Loop)

All RDL-2000 systems should be installed with an Ethernet cable drip loop to reduce mechanical strain on the RDL-2000 Ethernet port. A drip loop should also be used when mounting lightning protection devices to avoid mechanical stress and excess water flow at the Ethernet wiring ports.

4.5.2 System Grounding

A grounding connection is located on the RDL-2000 chassis. Use this screw to terminate a grounding wire.

⚠ CAUTION System Grounding Procedures

Correct grounding is very important for safe operation of wireless equipment -- ensure that all grounding connections are made in accordance with local and national standards.

The following general industry practices are provided as a guideline only:

1. All grounding connections must be made in accordance with local and national standards. Painted or dirty surfaces should be cleaned thoroughly down to bare metal and screws should be well tightened.
2. Provide a direct ground connection from the antenna-mounting bracket, the RDL-2000 unit, and any lightning protection equipment, to the same ground point on the tower. Use the grounding screw on the antenna bracket and the grounding screw on the RDL-2000 to terminate the ground wires. Avoid making sharp bends in the ground wires.

4.5.3 Lightning Protection Guidelines

All outdoor wireless equipment is susceptible to lightning damage. Lightning protection and grounding practices per the local and national electrical codes serve to minimize possible equipment damage, service outages, and serious injury. Common reasons for these damages can be summarized as follows:

- Tower/Antenna sites that are not grounded properly may conduct high lightning strike energy.
- Lack of installed lightning protection equipment may cause equipment failures resulting from lightning induced currents.

The grounding system should provide a low-impedance path to ground for the lightning-induced current. A loose ground connection is a source of noise and may cause sensitive equipment to malfunction.

The tower grounding system disperses most of the surge energy from a tower strike away from the building and equipment. The remaining energy on the Ethernet cable shield and center conductor can be directed safely to ground by using a lightning arrestor in series with the Ethernet cable.

Grounding Guidelines

NOTICE The following are general recommendations for system installation. This equipment must be installed by a qualified professional installer and follow local and national codes for electrical grounding and safety. Failure to meet safety requirements and/or use of non-standard practices and procedures could result in personal injury and damage to equipment. A direct lightning hit may cause serious damage or injury even if these guidelines are followed for the system.

The following general industry practices are provided as a guideline only.

- All grounding connections must be made in accordance with local/national standards.
- Painted or dirty surfaces should be cleaned thoroughly down to bare metal and screws should be well tightened.

- Avoid sharp bends in the ground wire.
- The installation site should have had an external ground ring or bus bar.
- Above ground wire must be #2-6 AWG when interconnecting ground rings and #6 AWG (minimum) for grounding equipment and any metal objects
- Below ground wire must be #2 AWG (minimum).
- Ground rods must be 8 feet long (minimum) and 5/8-inch in diameter. Rods must extend 3 feet below any adjacent basement/vault.
- A grounding block should be installed where cables enter the building.

This section describes mounting of the RDL-2000, recommendations for grounding and line protection equipment, and rough alignment of the antenna.

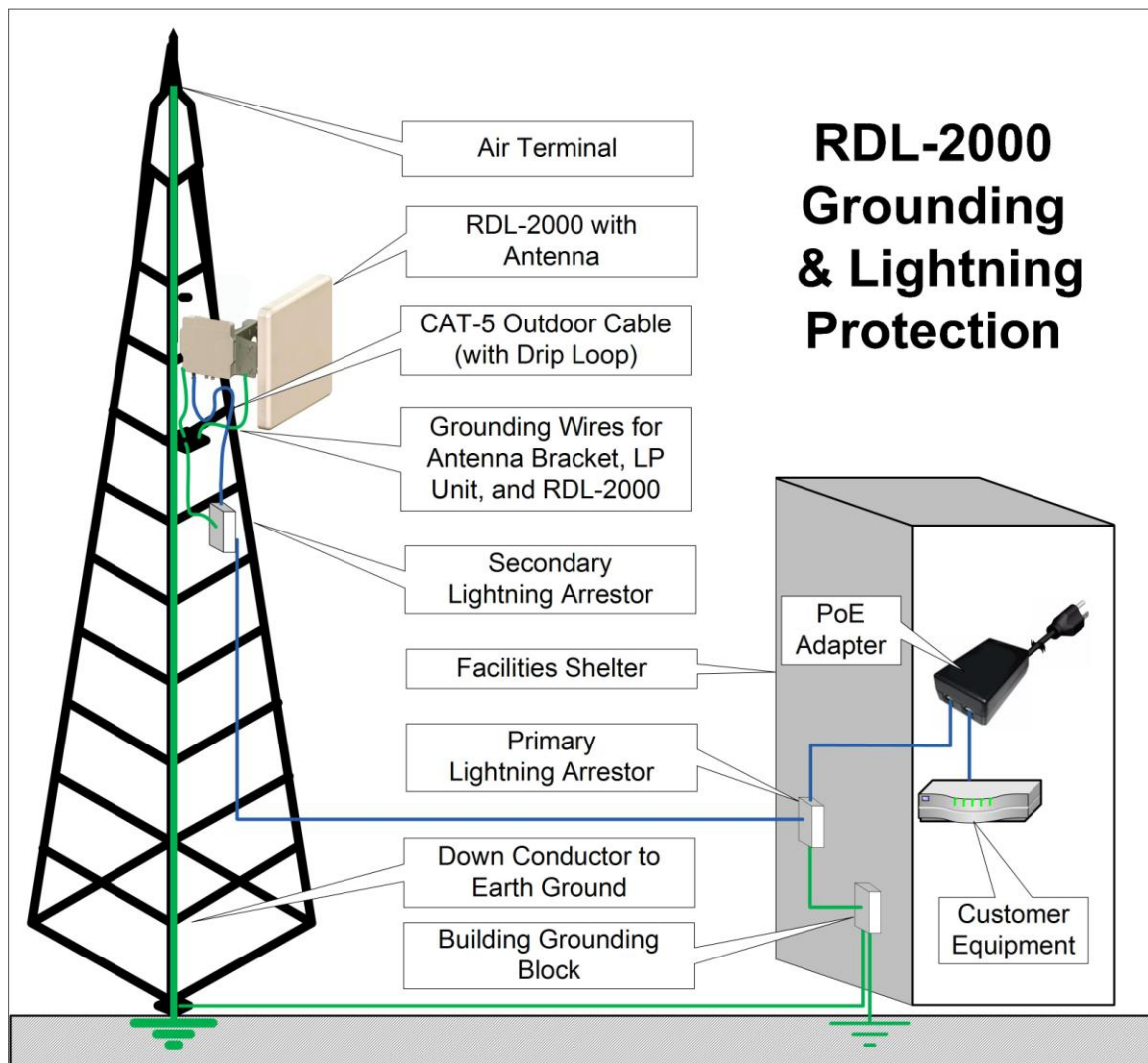


Figure 21: Mounting - Grounding & lightning Protection

The following recommendations are general industry practices:

- The antenna mast/tower must be connected to the master earth ground.
- It is recommended to pre-assemble and test the RDL-2000 equipment (RDL-2000, mounting bracket, and antenna) and connection wiring before final installation of the units. Mount the pre-assembled RDL-2000 on the antenna mast.
- Direct grounding from the RDL-2000, the mounting bracket, the antenna, and the Ethernet cable surge protection to the same ground bus on the building should be provided. Terminate ground wires using the grounding screws provided on the RDL-2000 and the antenna mounting bracket.
- A lightning arrestor should be installed in series with the Ethernet cable as close to the RDL-2000 unit as practical. The grounding wire should be connected to the same termination point used for the tower or mast.
- A lightning arrestor should be installed in series with the Ethernet cable at the point of entry to the building. The grounding wire should be connected to the same termination point used for the tower or mast.
- If AC PoE is used, the AC wall outlet ground for the indoor POE adapter should be connected to the building grounding system.

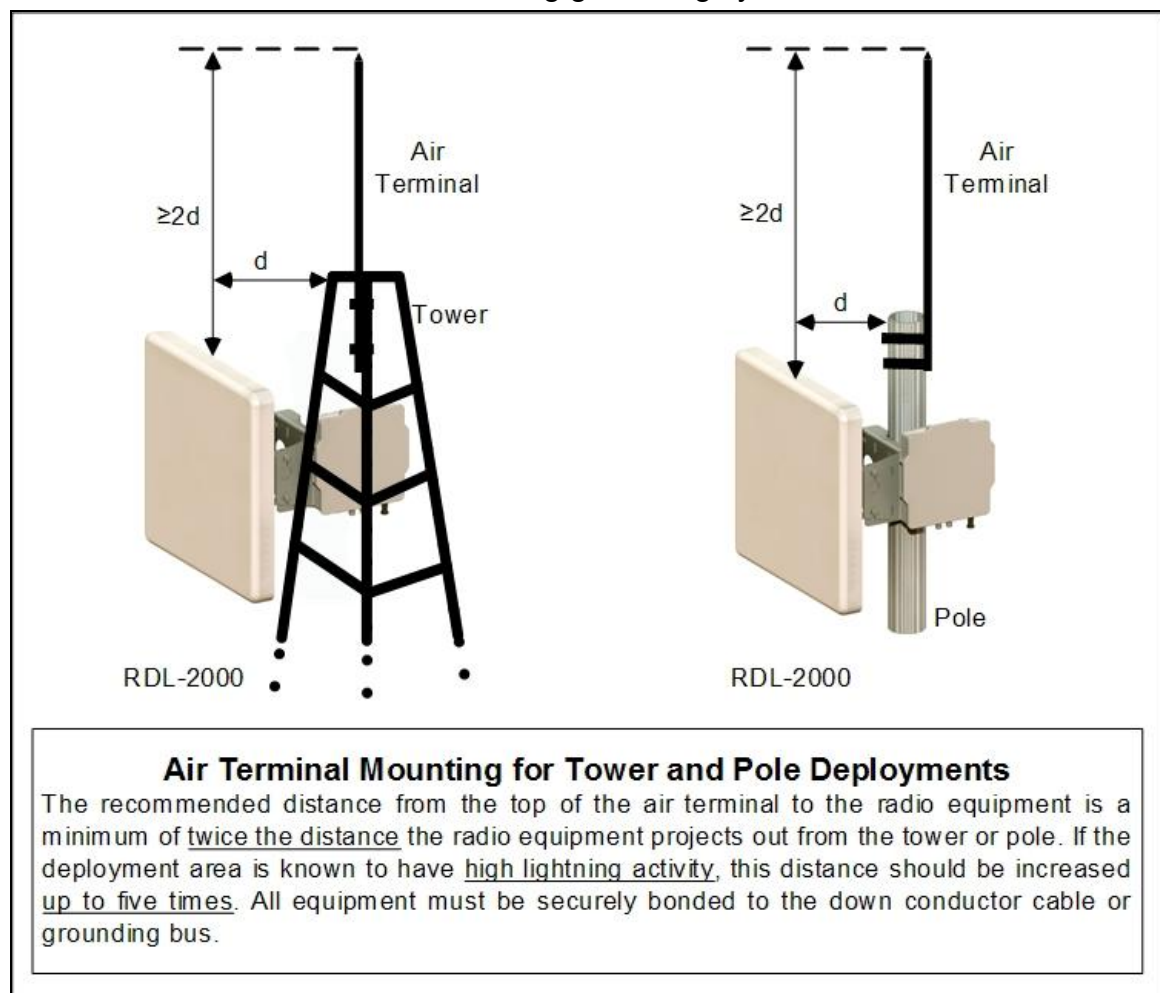


Figure 22: Mounting - Air Terminal for Tower and Pole Deployments

Installing Ethernet Lightning Arrestors

If you have determined that it is appropriate to install lightning protection for your system, the following general industry practices are provided as a guideline only:

Installing the Line Protector Unit

This section describes the steps required to install the Ethernet line protector. It is recommended to pre-wire the LP device and test all connections before final outdoor installation. Connect the LP unit according to the direction it is labeled. Each side of the unit has been labeled SURGE and PROTECTED for this purpose. Do not switch Ethernet wires from input to output. The unit may be mounted/grounded on a nearby plate or bulkhead panel that is bonded to an earth-ground system.

Installing the POE Line Protector Unit

⚠ CAUTION Do not install during adverse weather conditions when the threat of a lightning strike is possible.

Connect this unit in the direction it is labeled. Each side of the unit has been labeled SURGE and PROTECTED for this purpose. Do not switch Ethernet wires coming in and going out. For -IG (isolated ground) units, they are marked 2 X FEED and 2 X RTN (RETURN). The unit may be mounted/grounded on a nearby plate or bulkhead panel that is bonded to an earth-ground system.

1. Mounting: Ground the unit with provided 2 X 8-32 screws to the pattern below.
2. Terminal Block: Wire gauge; 16-28 AWG. Wire strip length; 0.25". Tightening torque; 2.21 lb-in. (0.25 N-m).
3. Lid: 4 X M4 X 20 mm screws. Be sure the neoprene gasket on the lid is not loose and is properly fitted into the groove. Tightening torque; 11 lb-in. (1.24 N-m).

Outdoor Units: Be sure all conduit fittings are used and torqued to meet environmental specifications. Conduit fittings have O-rings to ensure environmental seal.

⚠ CAUTION FOR CORRECT OPERATION, IT IS VERY IMPORTANT THAT THE LINE PROTECTOR IS PROPERLY CONNECTED TO A LOW IMPEDANCE (LOW R AND LOW L) GROUND SYSTEM.

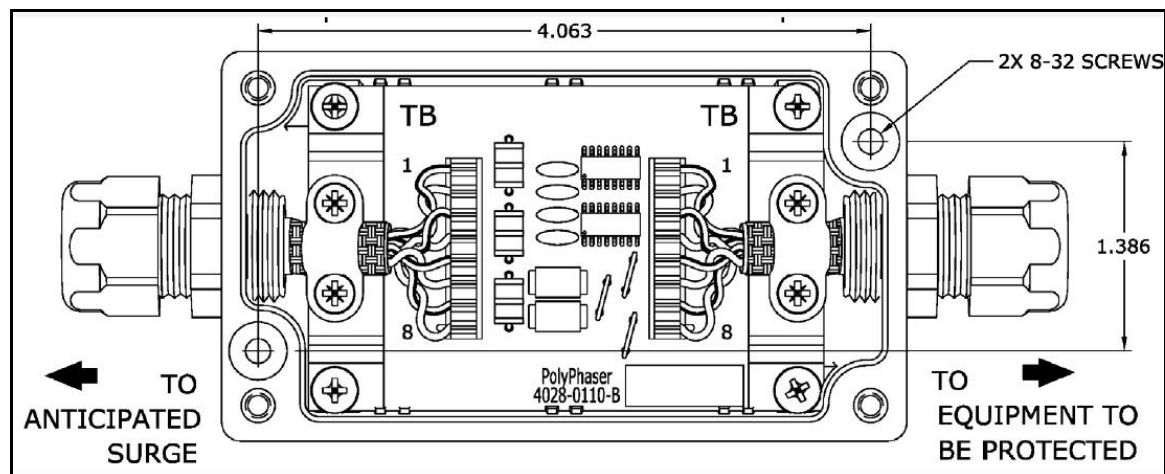










Figure 23: Lightning Protection - Terminal Connection Identification

Note: LP terminal block assignment is identical for both screw-type and 110Connect.

Table 10: Outdoor Line Protection Wiring Diagram

Terminal Block (TB)	Signal	Color Code	Wire Color
1	Rx +		White / Orange
2	Rx -		Orange
3	Tx +		White / Green
4	Tx -		Green
5	48 (+)		Blue
6	48 (+)		White/Blue
7	48 (-)		White/Brown
8	48 (-)		Brown

Line Protector Mast Mounting Kit

This kit is used for mounting the lightning protector to a 76 - 127 mm (3-5 in) diameter pole.

Note: The Polyphaser IX-Pole-Kit kit is not available directly from Redline, and must be ordered separately (if required) from a telecom equipment distributor.

1. Align box cover plate (1) mounting holes (Pemstuds facing out) with mounting holes on the LP box.
2. Insert screws (2) through the LP box and cover (1), secure with #8 washer (5) and nut (4).
3. Attach bracket (3) onto Pemstuds of assembly cover (1) using #10 washer (7) and nut (6).
4. Slide hose clamp (8) through both slotted grooves of bracket (3), attach hose clamp to pole.

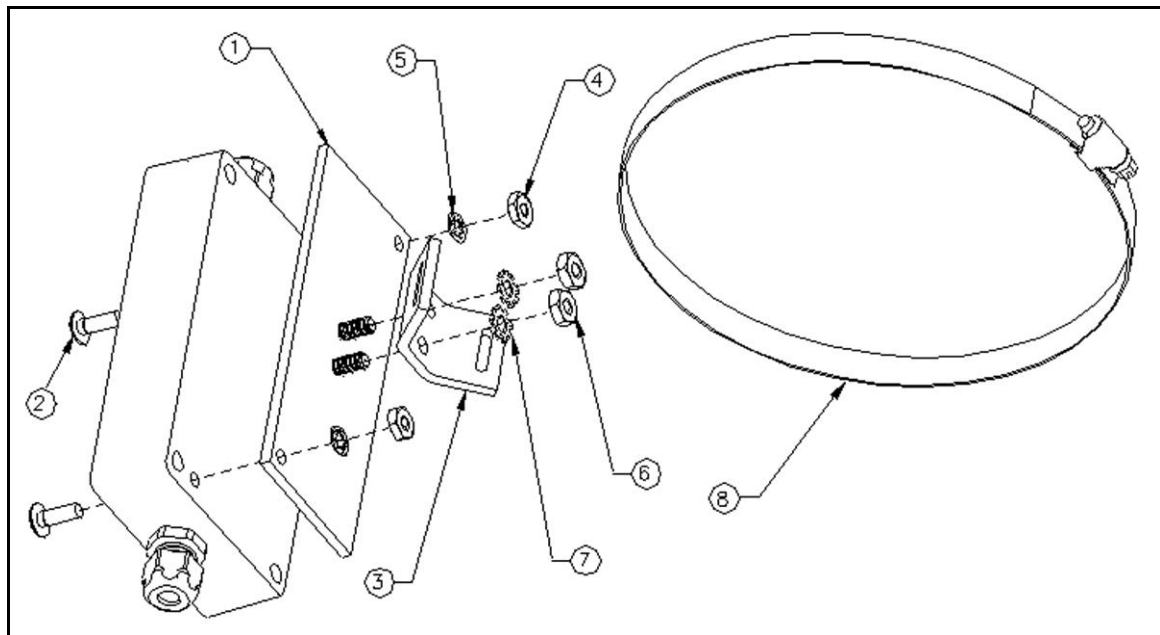


Figure 24: Lightning Protection - Mounting Kit

Table 11: Lightning Protection - Mounting Kit Parts List

Item	Description	Qty.	Item	Description	Qty.
1	Assm Bracket	1	5	Washer #8 int.	2
2	Screw 8-32 x 0.5	2	6	Nut #10	2
3	Bracket Mnl Dbl Bend	1	7	Washer #10	2
4	Nut #8	2	8	Clamp Hose 3-5 in.	1

Weatherproof LP Connections

It is important to weatherproof both ends of the line protection unit.

1. Begin to wrap the splicing tape. Start as close to the LP housing as possible. Stretch and wind the tape back along the connector housing making very sure there are no gaps in the tape.

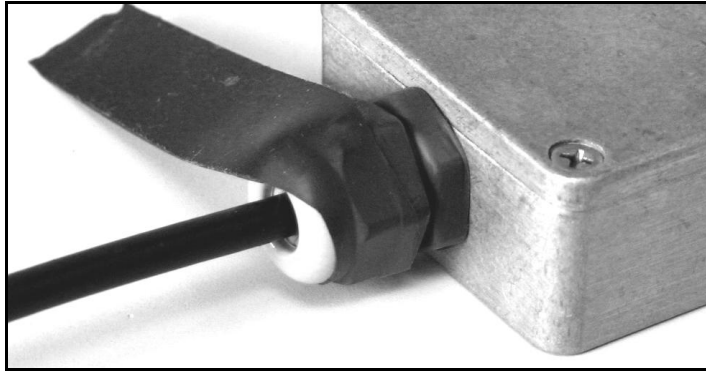


Figure 25: LP Ethernet Cable Entry Weatherproofing - Pt-1

2. Continue to wrap the tape tightly along the cable.

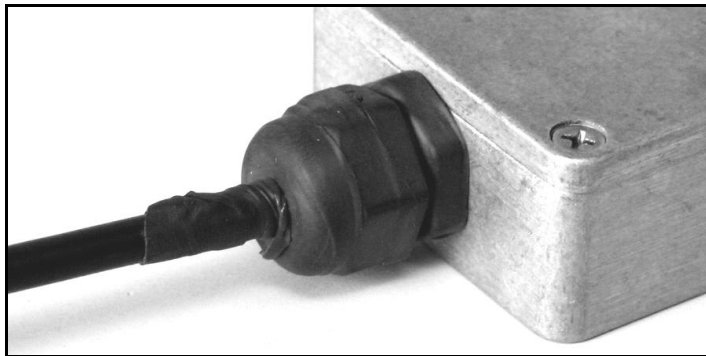


Figure 26: LP Ethernet Cable Entry Weatherproofing - Pt-2

3. Work the mastic putty into the area between the connector and the body of the LP. Continue to work the putty in making a watertight seal. The connection is now well weatherproofed.

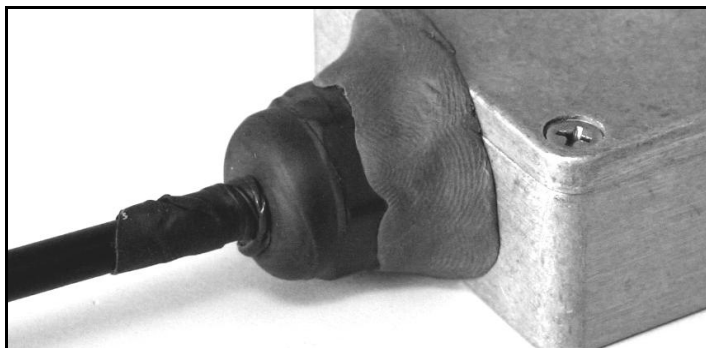


Figure 27: LP Ethernet Cable Entry Weatherproofing - Pt-3

Repeat this procedure for both cable connections to the LP.

4.5.4 Install Indoor PoE Power Adapter

The indoor Power-over-Ethernet (PoE) power adapter provides operational power and the Ethernet connection to the RDL-2000. The PoE is auto-sensing 110-240 VAC. A grounded AC outlet must be provided within about one meter of the PoE adapter mounting location. The AC power cable is supplied with a grounding power plug. Do not defeat this important safety feature.

The indoor end of the Redline supplied Ethernet cable is terminated with a non-hooded RJ-45 connector. This connects to the OUTPUT (DATA & POWER) port of the indoor PoE power adapter. The minimum diameter conduit or hole required is 18 mm (11/16 in).

The power block provides two Ethernet interfaces:

INPUT (DATA): Connection to local network equipment.

OUTPUT (DATA & POWER): Signal and power to the RDL-2000.

⚠ CAUTION Warning to Service Personnel: 48 VDC

Customer equipment including personal computers, routers, etc., must be connected only to the INPUT (DATA) port on the PoE unit. Only the outdoors Ethernet interface cable connecting to the RDL-2000 can be safely connected to the OUTPUT (DATA & POWER) connector. Connecting customer premises Ethernet equipment directly to the OUTPUT (DATA & POWER) connector on the Power-over-Ethernet power adapter may damage customer equipment.

4.5.5 Step 5: Configure the RDL-2000

This step describes using the system configuration and monitoring options available using the Redline Link Manager application. This application provides all settings necessary to configure, monitor, and troubleshoot operation of the RDL-2000 wireless link. The operator can access and control the RDL-2000 locally or remotely using IP connectivity over the network connection. The CLI interface is a general monitoring tool and does not include all commands necessary to setup and monitor the RDL-2000.

4.5.6 List of Required Parameters

The following table summarizes the steps required to configure the RDL-2000 unit. Parameters must be configured in the stated order. Enter all parameter settings on each screen and then click the Submit button to save these changes. If the unit automatically reboots, start a new session and continue with the next step. Changing screens without clicking the Submit button will discard all changes made in that screen.

NOTICE The RDL-2000 must have a license file installed before placing unit in-service. After changing the license file, you must exit and re-start the Link Manager application.

Table 12: Installation - Step by Step Configuration of RDL-2000					
Step	Screen	Parameter	Reference	Master	Slave
1	License	License File ¹	MAC Address		
2	Link Config	Channel BW ²	RF Plan		
		Unit Type ²		PTP Master	PTP Slave
		Enable MIMO		Enable <input checked="" type="checkbox"/>	Enable <input checked="" type="checkbox"/>
		MU ID	RF Plan		N/A
		SU MAC Address	MAC Address		N/A
		Channel	Network Plan		N/A
		Enable ACS		Disable <input type="checkbox"/>	N/A
3	Advanced	Activate ATPC		Enable <input checked="" type="checkbox"/>	Enable <input checked="" type="checkbox"/>
		Band	RF Plan		
		Adaptive Modulation		Enable <input checked="" type="checkbox"/>	N/A
		Antenna Gain	RF Plan		
		M. Tx Power	RF Plan		
4	Installation	IP Address	Network Plan		
		Subnet Mask	Network Plan		
		MU ID	Network Plan	N/A	
		RF Channels	RF plan	N/A	

1. After changing the license file, you must exit and re-start the Link Manager application.

2. When changing the Unit Type and/or Channel BW, you must click the Submit Parameters button to make these changes active before continuing with the configuration setup. The RDL-2000 unit will reboot.

4.5.7 Installing the Link Manager Application

The Link Manager application must be installed using the installer provided on CD-ROM.

1. Insert the CD-ROM into the PC, browse to the CD and double-click on the program:

Link_Manager_V1_000x.exe

2. Follow on-screen instructions to install the Link Manager.

Note: Windows™ 7 users must install WinPcap v4.1.1 before installing Link Manager.

4.5.8 Start a Session with an RDL-2000

1. Use a standard Ethernet cable to connect the PC directly to the PoE Data In port. It is not required to know the IP address of the RDL-2000.
2. Click **Tools->Select Adapter** and select the applicable LAN Ethernet interface.
3. Click **S** on the command bar (or press CTRL-S) to start a session. Click to highlight the RDL-2000 in the pop-up dialog. Select user type **Admin**, enter the password **admin**, and click **Login** to begin a session.

Note: If the login is not successful, review the status messages in the Link Manager log.

Refer to the RDL-2000 User Manual for detailed information about Link Manager features and operation.

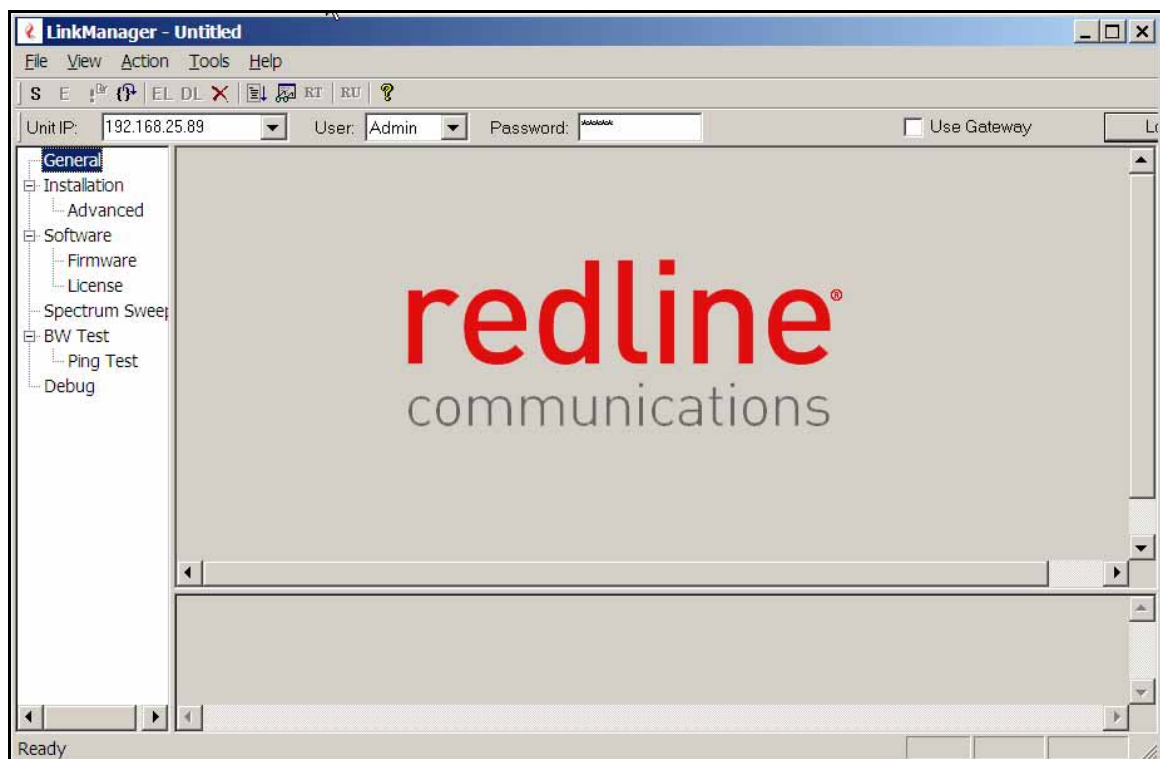


Figure 28: Link Manager - Start Screen

4.5.9 Configure PTP Slave

The following instructions must be performed in the order listed. The configuration listed here is to facilitate installation only. Refer to your detailed RF plan for any other required parameter settings.

1. Start the Link Manager (Start-> Link_Manager-> Link_Manager), click 'S' on the toolbar to start a session, and login as Admin.
2. Display the **License** screen and Drag & Drop the licence file for this MAC address onto the license screen. Click Submit to activate the license. The RDL-2000 will automatically reboot.

Important: Exit from the Link Manager after changing the license file, and then re-start the Link manager application to load the new RDL-2000 settings.

3. **PTP Slave Link Configuration Screen**
 - a. **Channel BW** (see RF plan).
 - b. **Enable MIMO** = ☒ (Enabled)
 - c. **Unit Type** = PTP Slave
 - d. Click **Submit Parameters** (RDL-2000 may automatically reboot).

Pre-Shared Key:

Enable AES: ☐

Enable IIS: ☒

Vlan ID:

Unit Type:

Channel BW:

Enable MIMO: ☒

Get Parameters

Submit Parameters

Figure 29: Link Manager - Slave - Link Configuration Screen

4. PTP Slave Advanced Screen

- a. **Activate ATPC** = ☒ (Enabled)
- b. **Band** (see RF plan).
- c. **Antenna Gain** (see RF plan).
- d. **M. Tx Power** (max. Tx Power) (see RF plan).
- e. Click **Submit** (RDL-2000 may automatically reboot).

The screenshot displays the 'Link Manager - Slave - Installation->Advanced Screen' with the following configuration details:

- General Configuration:**
 - Admin Login Password: admin
 - User Login Password: user
 - ☐ Enable Buzzer
 - ☐ DFS
- Ethernet Configuration:**
 - Port 1 Configuration: Auto Negotiation
 - Port 2 Configuration: Auto Negotiation
 - ☐ Enable Security (VLAN)
- TX Power Configuration:**
 - Antenna Gain: 28.0 dbi
 - Cable Loss (dbm): 1
 - M. Tx Power (dbm): 22
 - Total: 49
- Regulation:**
 - Band: 5.725 - 5.850 GHz
- Power Control (ATPC):**
 - ☒ Activate ATPC
 - Current Tx Power: 22
- IIS Value:**
 - IIS Level: 6
 - Set Default

A 'Submit' button is located in the top right corner.

Figure 30: Link Manager - Slave - Installation->Advanced Screen

5. **PTP Slave Installation Screen**
 - a. **IP Address** (RF plan).
 - b. **Subnet Mask** (RF plan).
 - c. **MU ID** (RF plan).
 - d. **RF Channel Scan**: Disable selected RF channels if required (RF plan).
 - e. Click **Submit** (RDL-2000 may automatically reboot).
6. Click **RU** or select menu item **Action->Reset Unit** to reboot the RDL-2000.
7. Initial configuration of the PTP Slave is now complete. Proceed to the configuration of the PTP Master.

MAC Address: 00 09 02 02 5F E9

IP Address: 192 . 168 . 30 . 227 a

Subnet Mask: 255 . 255 . 255 . 0 b

MU ID: 00 09 02 02 60 00 c

Operational Mode: Online - Link Up

Channel: CH 02 [5.735 GHz] d

Submit

RF Channel Scan

- ☒ CH 01 [5.730 ...]
- ☒ CH 02 [5.735 ...]
- ☒ CH 03 [5.740 ...]
- ☒ CH 04 [5.745 ...]
- ☒ CH 05 [5.750 ...]
- ☒ CH 06 [5.755 ...]
- ☒ CH 07 [5.760 ...]
- ☒ CH 08 [5.765 ...]
- ☒ CH 09 [5.770 ...]
- ☒ CH 10 [5.775 ...]
- ☒ CH 11 [5.780 ...]
- ☒ CH 12 [5.785 ...]

RSSI: -60dbm
Max
Y->
R->

PER: 0%
Max
Min

Figure 31: Link Manager - Slave - Installation->Basic Screen

4.5.10 Configure PTP Master

The following instructions must be performed in the order listed. The configuration listed here is to facilitate installation only. Refer to your detailed RF plan for any other required parameter settings.

1. Start the Link Manager (Start-> Link_Manager-> Link_Manager), click 'E' on the toolbar to start a session and login as Admin.
2. Display the License screen and Drag & Drop the licence file for this MAC address onto the license screen. Click Submit to activate the license. The RDL-2000 will automatically reboot.

Important: Exit from the Link Manager after changing the license file, and then re-start the Link manager application to load the new RDL-2000 settings.

3. PTP Master Link Configuration Screen

- a. **Channel BW:** This must match the slave unit (RF plan).
- b. **Enable MIMO:** ☒ (Enabled)
- c. **Unit Type** = PTP Master

Important: If the unit is currently a PTP Slave, you must click **Submit** to reboot the unit in PTP Master mode before continuing the setup.

- d. **MU ID:** Enter SU ID of connected slave unit (RF Plan).
- e. **SU MAC Address:** Enter MAC of connected slave unit.
- f. **Channel:** Select the required RF channel from the list (RF Plan).
- g. **Enable ACS:** ☒ (Enabled).
- h. Click **Submit Parameters** (RDL-2000 may automatically reboot)

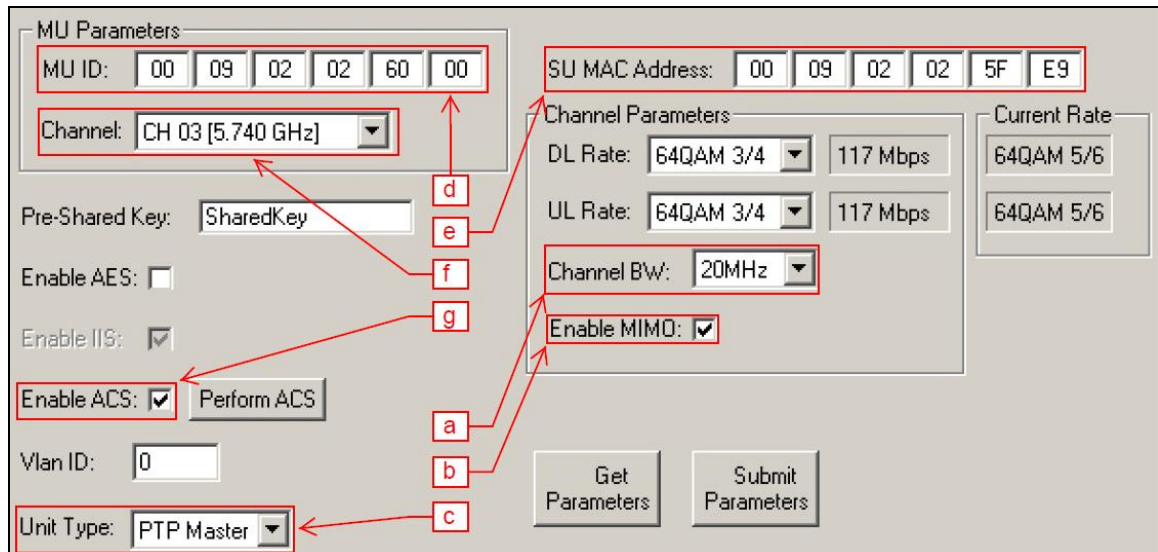


Figure 32: Link Manager - Master - Link Configuration Screen

4. PTP Master Advanced Screen

- a. **Activate ATPC:** ☒ (Enabled)
- b. **Band:** Must match slave unit (RF plan).
- c. **Adaptive Modulation:** ☒ (Enabled)
- d. **Antenna Gain:** See RF plan.
- e. **M. Tx Power:** See RF plan.
- f. Click **Submit** (RDL-2000 may automatically reboot).

The screenshot displays the 'Link Manager - Master - Installation->Advanced Screen' with the following configuration details:

- General Configuration:**
 - Admin Login Password: admin
 - User Login Password: user
 - ☐ Enable Buzzer
 - ☒ Adaptive Modulation
 - ☐ DFS
- Ethernet Configuration:**
 - Port 1 Configuration: Auto Negotiation
 - Port 2 Configuration: Auto Negotiation
 - ☐ Enable Security (VLAN)
- TX Power Configuration:**
 - Antenna Gain: 28.0 dbi
 - Cable Loss [dbm]: 1
 - M. Tx Power [dbm]: 14
 - Total: 41
- Regulation:**
 - Band: 5.725 - 5.850 GHz
- Power Control (ATPC):**
 - ☒ Activate ATPC
 - Expected Rx Power: -50
- Fixed Frame Mode:**
 - Mode: Disable
 - Signal Count: 0
- IIS Value:**
 - IIS Level: 6
 - Set Default

A 'Submit' button is located at the top right of the interface.

Figure 33: Link Manager - Master - Installation->Advanced Screen

5. **PTP Master Installation Screen**
 - a. **IP Address** See RF Plan.
 - b. **Subnet Mask** See RF Plan.
 - c. Click **Submit** (unit may automatically reboot).
6. Click **RU** or select menu item **Action->Reset Unit** to reboot RDL-2000.
7. Initial configuration of the PTP Master and PTP Slave is now complete. Proceed to the antenna alignment section.

MAC Address: 00 09 02 02 5F EB

IP Address: 192 . 168 . 30 . 226

Subnet Mask: 255 . 255 . 255 . 0

Submit

Operational Mode: Online - Link Up

Channel: CH 02 [5.735 GHz]

RSSI: -57dbm

PER: 0%

Y->

R->

Max

Min

Figure 34: Link Manager - Master - Installation->Basic Screen

4.6 Step 6: Antenna Alignment

4.6.1 Basic Antenna Alignment

Correct antenna alignment is essential in obtaining the maximum performance from the wireless link. A misaligned antenna will result in decreased receive signal strength and you may be unable to establish the wireless link.

The alignment must be performed in both the azimuth and elevation planes. Before installing the equipment, obtain accurate antenna pointing azimuth and elevation angles for each installation site (see section 0:

Site Survey Information on page 12). This will allow approximate alignment of antennas by using GPS or magnetic compass.

Antenna Polarization

The same antenna polarization must be used for both RDL-2000 units in a SISO (single antenna system) PTP link. The arrows on the rear of the antenna indicate the polarization.

Azimuth Alignment

Use a magnetic or GPS compass to obtain the approximate azimuth direction. Note that a metal tower will affect the accuracy of a magnetic compass. Magnetic declination (the difference between true North and Magnetic North) must also be taken into account.

The azimuth is aligned by loosening the bolts on the pipe bracket and rotating the antenna around the pole. To adjust the azimuth, loosen the four bolts identified in the figure on this page.

Elevation Alignment

Most links will have an elevation of zero degrees. The antenna can be set vertically (to a close approximation) using a bubble (spirit) level. This method is not accurate for elevation settings of greater than 5 degrees.

To adjust the elevation, loosen the four bolts identified in the figure on this page.

4.6.2 Fine Antenna Alignment Using RSSI

The RDL-2000 must be connected to the Ethernet PoE adapter and configured before the antenna alignment can be completed.

Antenna adjustments can also be made based on RSSI measurements reported by the RDL-2000. The RSSI information is available using the built in audible antenna alignment tool (Buzzer) or using the Link Manager application.

Slowly adjust the antenna elevation, and then azimuth in a broad sweeping pattern, while observing the peaks and valleys in the RSSI readings.

While sweeping the antenna, the RSSI value will rise when aligned to a sidelobe, and then fall and rise to the highest reading when the receiver is properly aligned to the main beam. Further movement of the antenna will cause the RSSI to fall and then rise to a lower peak when aligned to another sidelobe.

When the alignment sweep has been completed, the measured RSSI value should be checked against the estimated value obtained from the link budget. If the wireless link is LOS, the measured RSSI value should be within 5 dBm of the calculated value.

A lower or fluctuating RSSI value may indicate that the antenna is aligned to a sidelobe. If the RSSI value is much lower than the link budget prediction, this may indicate an optical LOS or non-LOS path. If the link is non-LOS, a suitable reflecting surface such as a building or billboard must be used. For non-LOS deployments, it is necessary to install the link and perform vertical and horizontal sweeps of the antenna to determine if the required throughput can be achieved.

When the alignment is complete, tighten bolts to 13.5 n-m (10 ft-lbs). Tighten each bolt in a cross-pattern to minimize shifts in the antenna alignment.

5 Reference Information

5.1 Protecting Cables from High Temperature & Abrasion

Temperature and abrasion may damage the outdoor cables and lead to a degradation in service. It is recommended to review the following information about protecting outdoor cables. In extremely hot climates, the outdoor cable may be degraded when the temperature of the metal tower structure exceeds the maximum specified cable rating. In windy climates, excessive abrasion may damage the cables.

Redline recommends the use of suitable diameter spiral bound sleeve (generically called 'spiroband') to protect the outdoor cable. This product should be available from most local electrical suppliers.

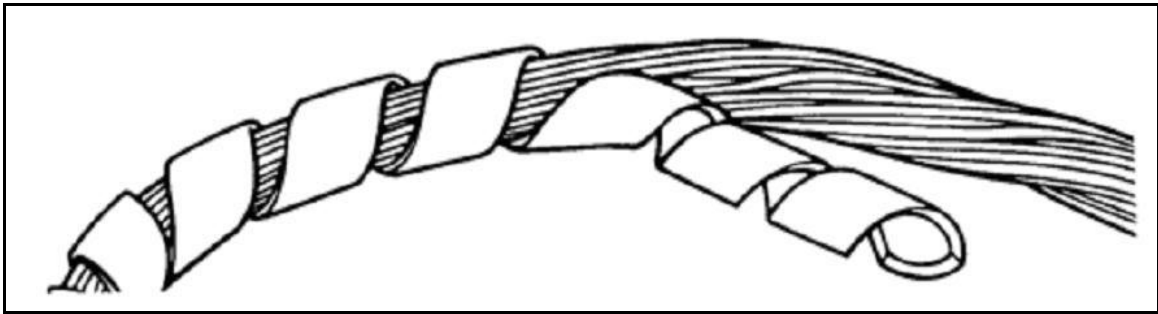


Figure 35: Ref. - Outdoor Cable Protection - Spiroband

Wrap the sleeve around the outdoor cable for at least 300 mm (~12 in) in each direction from bonding points and any other area the cable is in direct contact with the metal tower. Cable ties can be used in the normal way to secure the cable.

5.2 Bench Test Setup

5.2.1 Customer Supplied Equipment:

1. Windows™ computer with Redline 'Link Manager' application installed.
2. Second computer is preferred to perform link data testing.
3. Pair of RF attenuators (70 dB recommended) for indoor testing.
4. AC power (for PoE).

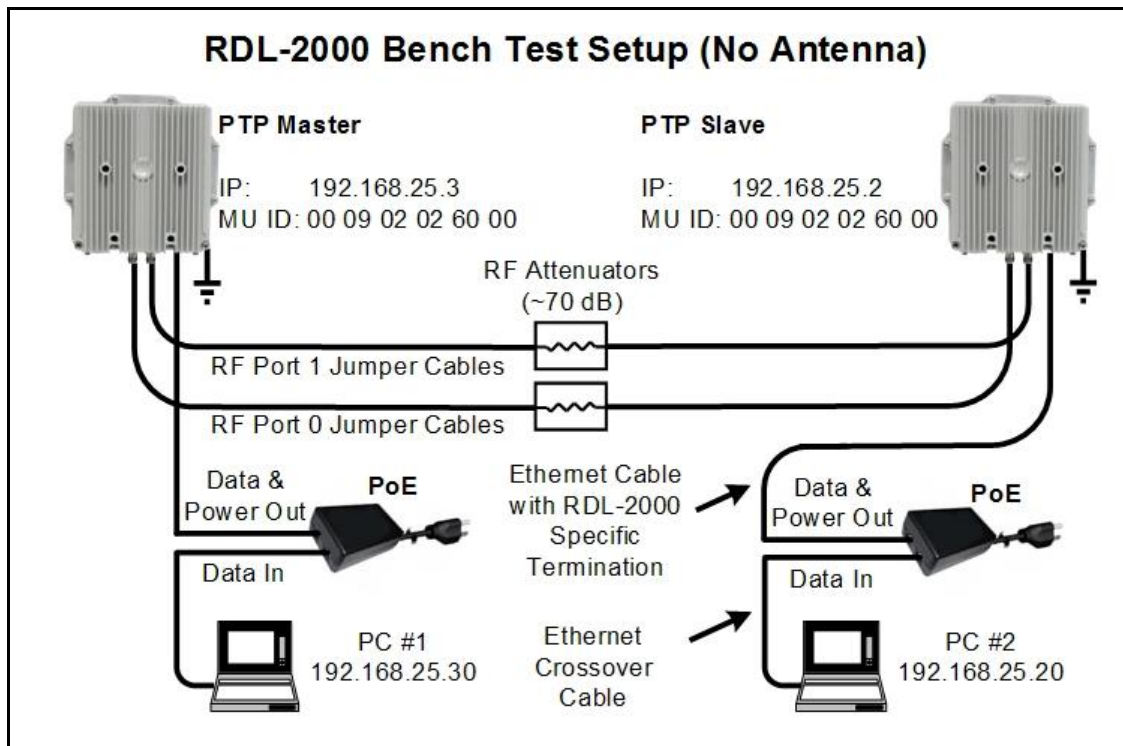


Figure 36: Ref. - Bench Test Setup (No Antenna)

Note: The default IP address is 192.168.25.2. The default Admin password is: *admin*. To avoid Layer-2 loops, only one RDL-2000 should be connected to a local LAN.

5.2.2 Assemble Test Setup

1. Connect the units as shown in the diagram and power on all equipment.
2. Transfer the RDL-2000 license files to PC#1 and PC#2.

5.2.3 Connectivity Test

1. On PC #1, go to the Ping screen. Set the test for 1024 byte packets, transmitted each 1000 ms, to address 192.168.25.2 (slave unit).
2. Click the Start button and observe that the slave unit is responding.
3. Click the Stop button to terminate the ping test.
4. Set the test for 5000 byte packets, transmitted each 1000 ms, to address 192.168.25.20 (PC #2).
5. Click the Start button and observe that that PC #2 is responding.
6. Click the Stop button to terminate the ping test.

5.2.4 Throughput Test

1. On PC #1, go to the Throughput Test screen. Set the address to 192.168.25.20 (PC #2), set the data rate to 10 Mbps, and click the Start button to begin transmitting data.
2. On PC #2, go to the Throughput Test screen and click the Rx button to start listening for data. Observe that the Rx counter adjacent to the Rx button indicates that data is being received and the rate is approximately 10 Mbps.
3. On PC #1, adjust the slider to increase the data rate and observe that PC #2 is correctly receiving at the same rate.
4. Click the End button on both PCs to stop the throughput test.

